BS EN 1794-1:2011

BSI Standards Publication

Road traffic noise reducing devices — Non-acoustic performance

Part 1: Mechanical performance and stability requirements

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National foreword

This British Standard is the UK implementation of EN 1794-1:2011. It supersedes BS EN 1794-1:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/509/6, Fences for the attenuation of noise.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Road traffic noise reducing devices - Non-acoustic performance - Part 1: Mechanical performance and stability requirements

Dispositifs de réduction du bruit du trafic routier - Performances non acoustiques - Partie 1: Performances mécaniques et exigences en matière de stabilité

Lärmschutzeinrichtungen an Straßen - Nichtakustische Eigenschaften - Teil 1: Mechanische Eigenschaften und Anforderungen an die Standsicherheit

This European Standard was approved by CEN on 10 December 2010.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Contents

Foreword

This document (EN 1794-1:2011) has been prepared by Technical Committee CEN /TC 226 "Road equipment", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2011, and conflicting national standards shall be withdrawn at the latest by July 2011.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1794-1:2003.

This European Standard consists of the following parts under the general title "*Road traffic noise reducing devices — Non acoustic performance*".

— *Part 1: Mechanical performance and stability requirements*

— *Part 2: General safety and environmental requirements*

The main changes compared to the previous edition are:

a) fatigue (A.2.3.2);

b) the wind load for low barriers;

c) addition to Annex A of a note on shape factors.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

Introduction

While performing their primary function, road traffic noise reducing devices are exposed to a range of forces due to wind, dynamic air pressure caused by passing traffic, and the self weight of its component parts. They can also be subjected to shocks caused by stones or other debris thrown up by vehicle tyres and, in some countries, the dynamic force of snow ejected by equipment used to clear roads in winter. The deflections of a noise reducing device under such loads during its design life should not reduce its effectiveness.

1 Scope

This European Standard specifies criteria to categorise road traffic noise reducing devices according to basic mechanical performance under standard conditions of exposure, irrespective of the materials used. A range of conditions and optional requirements is provided in order to take into account the wide diversity of practice in Europe. Individual aspects of performance are covered separately in the annexes. Safety considerations in the event of damage to noise reducing devices are covered in Part 2 of this European Standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1991-1-4, *Eurocode 1: Actions on structures — Part 1-4: General actions — Wind actions*

EN 1317-1, *Road restraint systems — Part 1: Terminology and general criteria for test methods*

EN 1317-2, *Road restraint systems — Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets*

EN 1794-2:2011, *Road traffic noise reducing devices — Non-acoustic performance — Part 2: General safety and environmental requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
noise barrier
noise reducing device which obstructs the direct transmission of airborne sound emanating from road traffic

3.2
cladding
noise reducing device which is attached to a wall or other structure to reduce the amount of sound reflected

3.3
cover
noise reducing device which either spans or overhangs the highway

3.4
structural element
element whose primary function is to support or hold in place acoustic elements

3.5
acoustic element
element whose primary function is to provide the acoustic performance of the device

3.6
mechanical test hammer
device of the type used for measuring the elasticity of hard surfaces

3.7
test area
central area of a full size panel enclosed by a margin of 125 mm from each edge, as shown in Figure C.2

3.8
vehicle occupants safe device
traffic safe noise reducing device for which a vehicle impact does not cause more danger to the occupants than allowed for safety barriers in EN 1317-2

NOTE However, it does not need to prevent the vehicle from going through it, nor is it presumed that parts of the device are prevented from becoming detached.

3.9
combined safety and noise barrier
traffic safe noise reducing device which fulfils all the requirements for safety barriers in a given containment class as defined in EN 1317-2

3.10
wind load
wind load that include all factors in this European Standard

3.11
design wind load
wind load specific to a geographical region as defined in Eurocodes (EN 1991-2-4)

3.12
dynamic load
load due to snow thrown against a noise reducing device by snow ploughing equipment

3.13
ploughing speed
speed of the snow ploughing equipment as it passes the noise barrier

4 Symbols and abbreviations

$C_e(z)$ exposure coefficient

C_p pressure coefficient

d deflection, in millimetres

d_{hmax} horizontal maximum deflection, in millimetres

d_{vmax} vertical maximum deflection, in millimetres

H_{nrd} total height of acoustic elements constituting the whole reducing device, in millimetres

h_{ae} height of a single acoustic element, in millimetres

L length of elements, in millimetres

L_S greatest length of structural element, in millimetres

L_A greatest free length of acoustic element (between its supporting structural elements), in millimetres

$q_{(v)}$ dynamic pressure due to passing vehicles, in Pascals

S load factor

S_G load factor (weight)

S_W load factor (wind)

V_{ref} mean wind velocity at height *z*, in metres per second

W wind pressure, in Pascals

z height above the ground, in metres

ρ air density, in kilograms per cubic metre

5 Requirements

5.1 General

Under any of the following loads, elements shall not become detached from their supports or fixings.

5.2 Wind load and static load

Limiting values for elastic and permanent deflections shall not exceed the values specified in Annex A.

To ensure connections do not fail load factors shall be applied in accordance with Annex A.

NOTE This European Standard permits specifying authorities to indicate that there is no requirement for resistance to wind or static load.

5.3 Vibration and fatigue effects

All the relevant standards are specified in A.2.3.2.

NOTE This European Standard permits specifying authorities to indicate that there is no requirement for vibration and fatigue effect.

5.4 Self weight

Under standard conditions the deflections shall not exceed the limiting values given in Annex B.

5.5 Impact of stones

Damage caused by controlled impacts shall not exceed the criteria specified in Annex C.

NOTE This European Standard permits specifying authorities to indicate that there is no requirement for resistance to the impact of stones.

5.6 Safety in collision

When safety in collision has to be assessed, the behaviour under impacts specified in EN 1317-2 shall be classified in accordance with Annex D.

NOTE This European Standard permits specifying authorities to indicate that there is no requirement for verification of safety in the event of an impact by an errant vehicle.

5.7 Dynamic forces from snow clearance

When the effects of dynamic forces from snow clearance have to be assessed, this shall be done in accordance with Annex E.

NOTE This European Standard permits specifying authorities to indicate that there is no requirement for resistance to the force of snow thrown sideways by clearance equipment.

6 Test report

6.1 Every test report on aspects of performance shall include the following information:

a) number and year of this European Standard, i.e. EN 1794-1:2011;

b) full description of the element or system tested, including manufacturer(s), part numbers, place and date of origin;

c) description of the method of sampling, if parts of manufactured elements are evaluated by testing;

d) place and date of the assessment, and the name of the assessor;

e) sufficient description of any tests carried out, any results measured and the conclusions drawn about the product together with any illustrations or photographs, all as specified in the appropriate annex.

6.2 A summary report shall be produced, identifying the aspects of performance for which detailed reports are available and the level of performance assessed, where appropriate.

Annex A
(normative)

Wind load and static load

A.1 General

The methods for calculating wind load on noise reducing devices have been harmonized to allow for the particular climatic conditions within each region.

As considerable differences existed in the methods of calculation used in different European countries, an effort has been made to define an acceptable level of performance by applying load factors to the basic load calculated to take account of its location. Limits are placed on deflections to avoid acoustic leakage either while the noise reducing device is being subjected to its design wind load or afterwards.

Adequacy of mechanical performance in fulfilling the structural criteria given in this annex is in general demonstrated by calculations taking into account the values of elastic limit, modulus of elasticity, and other factors relating to the materials employed in the construction. In cases where calculations are thought to be unreliable, tests are used to determine the resistance of the elements in the same arrangement as in the intended use of the noise reducing device.

The range of temperature over which performance is within acceptance criteria is determined to enable noise reducing devices to be appropriately specified for extreme conditions of heat or cold.

This annex specifies the mechanical requirements for noise reducing devices exposed to aerodynamic load, excepting the design of foundations. The method of calculating aerodynamic and static loads and the minimum mechanical requirements for structural and acoustical elements and fixing devices are given. Two sources of aerodynamic load are considered: firstly, wind forces and secondly, dynamic air pressure due to passing vehicles. The forces acting on noise absorbing cladding attached to supporting walls are also considered.

A.2 Aerodynamic load

A.2.1 General

Aerodynamic load shall be considered acting normal to the exposed surface of the noise reducing device.

NOTE Wind load and dynamic pressure due to vehicles can be assumed not to act simultaneously.

A.2.2 Design wind load

The design wind load shall be calculated in accordance with EN 1991-1-4, which is based on national maps showing basic wind speeds.

NOTE The calculations can also be carried out taking a basic wind speed from more precise data, using a return period of 50 years.

A.2.3 Dynamic effects due to vehicles

A.2.3.1 Dynamic pressure

For the standard cases a) to c), the following values of dynamic pressure (or suction) in Pascals, shall be used:

a) traffic of vehicles in open air at a distance of 1 m from the noise reducing device and at a maximum speed of 100 km/h;

$q_{(v)}$ = 650

b) traffic of vehicles in open air at a distance of 3 m from the noise reducing device and at speeds higher than 120 km/h;

$q_{(v)}$ = 800

c) bi-directional traffic in a tunnel, at a distance of 1 m from the noise reducing device and maximum speed of 120 km/h;

$q_{(v)}$ = 1 500

d) in other cases, independent calculations shall be made to ascertain the magnitude of dynamic pressure.

A.2.3.2 Fatigue

If noise reducing devices are located close to either the side of roads or the ceiling of tunnels and covers, the combination of the following factors could lead to cycles of pressure differences and fatigue to occur:

(i) shape and speed of passing vehicles;

(ii) distance to and shape of the device.

The relevant standards are:

- EN 1991-1-4:2005, *Eurocode 1: Action on structures — Part 4 General actions — Wind actions*. Prescriptions are described in 7.4.1 wind loads for free standing walls and the number of loads for dynamic response is described in B.3.
- EN 1993-1-9:2005, *Eurocode 3: Design of steel structures — Part 1-9: Fatigue*. This code give all relevant information required for steel structures. The choice is described in EN 1993-1-9:2005, Table 3.1. Alongside roads “safe live” is required.
- EN 1999-1-1:2007*, Eurocode 9: Design of aluminium structures — Part 1-1: General structural rules*
- EN 1999-1-3:2007, *Eurocode 9: Design of aluminium structures — Part 1-3: Structures susceptible to fatigue*

A.3 Mechanical requirements for free standing noise barriers

A.3.1 General

The temperature range, within limits of - 30 °C to + 70 °C, over which the requirements in A.3.2 to A.3.4 are met shall be reported. For the purposes of calculation or test, temperature intervals of 10 °C shall be used.

A.3.2 Structural elements

A.3.2.1 General

In determining deflections of structural elements, rotation and displacements originating from foundations shall not be taken into account.

A.3.2.2 Vertical noise barriers

a) The maximum horizontal elastic deflection d_{hmax}, in millimetres, under the design wind load shall be less than;

$$d_{h\max} = \frac{L_S}{100} \text{ for } H_{\text{nrd}} \leq 3 \text{ m}$$

d_{hmax} = 30 mm for 3 m ≤ H_{nrd} ≥ 4,5 m

$$d_{h\max} = \frac{L_S}{150} \text{ for } H_{\text{nrd}} > 4{,}5 \text{ m}$$

b) when a load factor of S_{W} = 1,5 is applied to the design wind load;

i) the element shall not show any symptoms of failure such as buckling, permanent displacement of acoustic elements, or cracks greater than acceptable for exposure to a severe corrosive environment;

ii) the element shall not become detached from its supports or fixings;

iii) the permanent deformation d_{hmax}, in millimetres, after release of the load shall be less than;

$$d_{h\max} = \frac{L_S}{500}$$

A.3.2.3 Non-vertical noise barriers

Load due to snow, self weight, etc. shall be considered as acting together with wind load. The acceptance criteria are as given in A.3.2.2. except that additionally the elastic vertical deflection d_{vmax}, in millimetres, shall be less than:

$$d_{h\max} = \frac{L_S}{300}$$

A.3.3 Acoustic elements

A.3.3.1 General

An acoustic element shall not transmit loads from other acoustic elements to the structural elements unless this transmission is taken into account in the calculations.

A.3.3.2 Vertical noise reducing devices

a) The maximum horizontal elastic deflection, d_{hmax}, in millimetres, due to bending under the design wind load shall be less than:

d_{hmax} = min ($\frac{L_A}{40}$, 50 mm) for $L_A \leq 5$ m

$d_{\text{hmax}} = \frac{L_A}{100}$ for L_A > 5 m

b) when a load factor of S = 1,5 is applied to the design wind load;

i) the element shall not show any symptoms of failure such as buckling, permanent displacement of absorptive material, or cracks greater than acceptable for exposure to a severe corrosive environment;

ii) the element shall not become detached from its supports or fixings;

iii) the permanent deformation d_{hmax}, in millimetres, after release of the load shall be less than $\frac{L_A}{500}$

iv) the deflections of structural elements shall not cause acoustic elements to become permanently displaced.

A.3.3.3 Non-vertical noise reducing devices

Load due to snow, self weight, etc. shall be considered as acting together with wind load. The acceptance criteria are as given in A.3.3.2 except that additionally the elastic vertical deflection d_{vmax}, in millimetres, shall be less than $\frac{L_A}{200}$

A.3.4 Self supporting elements

A.3.4.1 Acoustic elements which are not supported or kept in place by another structure shall meet all the criteria given in A.3.3.1 to A.3.3.3.

A.3.4.2 Load bearing acoustic elements shall be designed to withstand all superimposed forces and meet the criteria specified in A.3.2 and A.3.3.

A.4 Mechanical requirements for fixings of acoustical elements or structures

A.4.1 Fixings for vertical noise reducing devices

Fixings such as bolts, welds, adhesives, etc. shall withstand the force which they are designed to support multiplied by a factor S = 1,5 without symptoms of failure such as cracks or plastic deformation.

A.4.2 Fixings for non-vertical noise reducing devices

Load due to snow, self weight, etc. shall be considered as acting together with wind load. The acceptance criteria are as given in A.4.1 except that the load shall be multiplied by a factor S = 1,75.

A.5 Noise absorbing cladding fixed to supporting walls

A.5.1 Cladding on free standing walls in the open

The mechanical requirements shall be as specified in A.3.2 and A.3.3 for free standing barriers under wind load and dynamic air pressure due to passing vehicles.

A.5.2 Cladding shielded from wind load (in deep cuttings and tunnels)

The mechanical requirements shall be as specified in A.3.2 and A.3.3 for free standing barriers, but only under dynamic air pressure load.

A.6 Calculation and test reports

A.6.1 Assessment of performance by calculation

The calculation report shall include full details of assumptions and parameters used including:

a) number and year of this European Standard, i.e. EN 1794-1:2011;

b) dimensions, including thickness of any reinforcement;

c) materials used, together with their elastic moduli, elastic limits and other relevant data;

d) theoretical basis of calculations;

e) name of the product and the name and address of the manufacturer;

f) name and address of the certifier of the calculation, with date and signature;

g) cross sectional drawing with dimensions;

h) results of calculations and assessment as to whether these indicate satisfactory performance for the specified load.

A.6.2 Assessment of performance by testing

A.6.2.1 General

The load test shall be carried out on a representative panel which shall include an appropriate number of acoustic elements of the longest span for the element type, with posts or other supports similar to those used in practice. The supports shall be held in the horizontal plane and restrained from lateral movement and rotation. The supports may be propped if only the flexure of the acoustic elements is to be tested, otherwise the supports shall be fixed solely at their base, as in use.

The test panel shall be allowed to reach equilibrium under laboratory conditions for at least 3 h before testing. Load tests shall be carried out at 20 °C. If the product is intended to be used at very low or very high temperatures, then the test may be repeated at - 20 °C and/or + 40 °C with appropriate conditioning time, if the material is regarded as being temperature sensitive.

A.6.2.2 Test procedure

The panel to be tested shall be supported as described in A.6.2.1. A 2 mm thick steel plate cut exactly to size (± 10 mm) excluding the supporting frame shall be carefully placed onto the exposed area of the acoustic elements. The point at which the vertical deflection under this loading is greatest shall be determined and all measurements of deflection relative to a fixed datum level shall be taken at this point. An initial deflection reading shall be taken 30 min after placing the steel sheet. The steel sheet shall then be removed and the deflection reading repeated after 30 min. The difference between these two readings shall be described as the deflection under self weight.

The steel sheet shall be replaced and an appropriate number of structural steel sections of the same length as the supports shall be uniformly distributed across the steel sheet parallel to the supports. The total weight of the structural sections including the steel sheet shall be equal to 1,5 times the total wind force (pressure x area) for which the panel is being tested. After 30 min under this loading, the deflection reading shall be repeated. The difference between this and the previous reading for loading by the steel sheet alone shall be described as the deflection under simulated wind load.

The structural sections shall be carefully removed and after 30 min the deflection reading shall be repeated. The difference between this and the previous reading for loading by the steel sheet alone shall be described as the permanent deflection.

A.6.2.3 Test report

The test report shall include a full description of the test arrangements, including details of supports, procedures and loading of elements.

It shall also include:

a) number and year of this European Standard, i.e. EN 1794-1:2011;

b) name and address of the testing institute with a dated signature of the person responsible;

c) exact identification of the tested element, the name and address of the manufacturer;

d) full description of the materials and their thicknesses;

e) weight of the element both wet and dry;

f) drawing showing the cross section of the tested element;

g) number of samples tested;

h) results of tests and assessment as to whether these indicate satisfactory performance for the specified load.

A.7 NOTE to Annex A – Shape factors for vertical and non-vertical noise reducing devices (informative)

When applying shape factors to calculate wind loading to either the ends of a noise reducing device, or where there are discontinuities in the height of the noise reducing device, shape factors other than those in EN 1991-1-4 are recommended. To determine these wind shape factors, the noise reducing device will be divided in 4 zones according to EN 1991-1-4. The zones A, B and C are situated near to the ends of a noise reducing device; zone D is in the middle of the noise reducing device. The dimensions of the zones are indicated in the Figures A.1 and A.2 below. An emergency exit will be treated like a normal D area as long as the height of the door is not equal with the height of the noise reducing device.

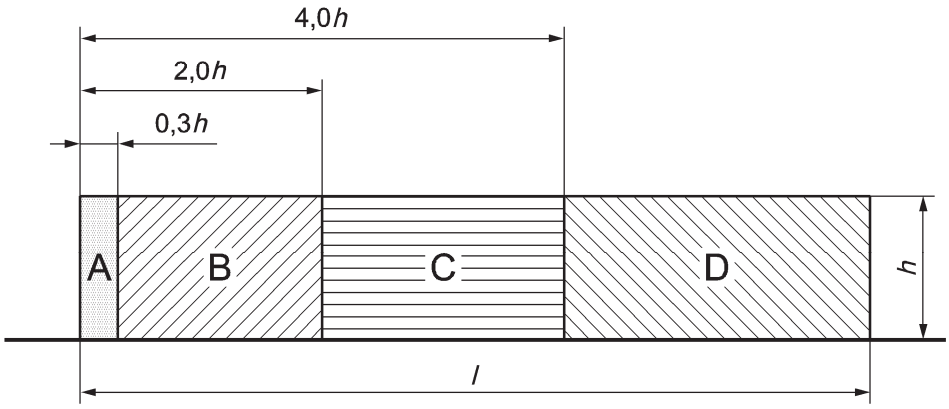
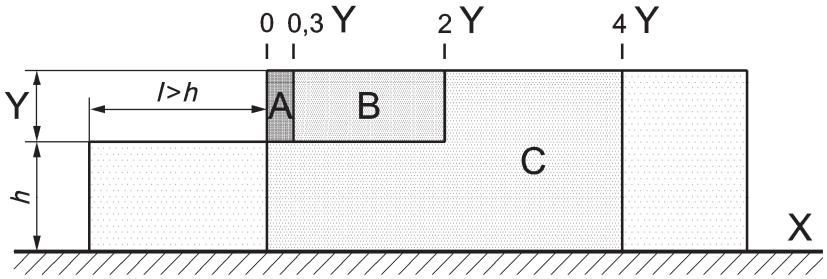


Figure A.1 — Dimensions of the zones for a noise reducing device of constant height



Key

X mv

Y h_{zone}

Figure A.2 — Dimensions of the zones for a noise reducing device where there are differences in height along its length

Figure A.1 indicates the dimensions of the zones for a noise reducing device of constant height. Figure A.2 indicates the dimensions of the zones for a noise reducing device where there are differences in height along its length.

The recommended wind shape factors are given in the Table A.1 below. For barriers which have T shaped tops, 0,1 shall be added to the factors in Table A.1.

For noise reducing devices at angles between 10° and 20° to the vertical, the additions should be determined by interpolation between 0,1 and 0,2.

Table A.1 — Shape factor C_{index} and additions for non vertical barriers

	C_{index} for vertical barriers	Additions to C_{index} for non vertical barriers	
Barrier zone			
	For α < 5°	For 5° < α < 10°	For α = 20°
A	3,4	0,1	0,2
B	2,8		
C	1,7		
D	1,2		

Annex B
(normative)

Self weight

B.1 General

The self weight of acoustical elements is used in two distinct ways. The dry weight is needed to make an approximation of the noise insulation value of the element. Where elements can absorb water, the wet weight is an important consideration in the design of both elements and supporting structures. Limits on deflections are necessary to avoid acoustical leakage, diminution of the height or overloading of the supporting structure.

Adequacy of mechanical performance in fulfilling the structural criteria given in this annex are demonstrated by calculations which take into account the values of elastic limit, modulus of elasticity, and other factors relating to the materials employed in the construction. In cases where calculations are thought to be unreliable, tests are used to determine the resistance of the elements in the same arrangement as in the intended use of the device.

Dry weight, wet weight and reduced wet weight are defined. The mechanical requirements due to weight of acoustical elements, acting alone and in combination with wind load, are specified. Methods of determining compliance with these requirements by means of calculation or testing are given.

B.2 Determination of self weight

B.2.1 Dry weight of acoustic elements

The dry weight of the acoustic element shall either be measured directly, or calculated from the specific gravity and the dimensions of the materials used. The weight per unit of surface area of an element shall be calculated as the minimum value, by ignoring frames and local reinforcement.

B.2.2 Wet weight of acoustic elements

The wet weight takes account of the fact that cavities and porous materials may become filled with water; all parts of the noise reducing device which absorb water shall be considered as acting with the weight of water added.

B.2.3 Reduced wet weight

Provided that the design of the construction and the elements are such that water is neither discharged from elements at the top of a device into elements below, nor retained in supporting structures, the wet weight of the element shall be measured as follows; the element shall be completely immersed under water for 24 h; it shall be removed and left to drain for no more than 10 min in the in-use position before weighing.

B.3 Mechanical requirements

B.3.1 Structural elements

Structural elements which support the weight of acoustic elements shall be designed to support the wet weight or the reduced wet weight of acoustic elements as appropriate with a load factor S of at least 1,5.

B.3.2 Acoustic elements under their own weight

The element shall support its own wet weight or reduced wet weight (as appropriate) and the appropriate wet weight of the elements which may be permitted to rest upon it without showing distress in accordance with the following criteria:

— local torsional instability: horizontal deflection d_{hmax}, in millimetres, shall be not greater than $d_{h\max}=\frac{h_{ae}}{50}$;

— vertical deflection: with the element supported as it is used in practice, the maximum deflection d_{vmax}, in millimetres, shall be not greater than $d_{v\max}=\frac{L}{400}$;

NOTE The roadside environment can be severely corrosive. Therefore cracking should be limited because it can lead to corrosion.

B.3.3 Combined weight, wind and static loads

Elements shall withstand without failure the combined loads multiplied by the given factors of their own weight as defined in B.3.2 and wind and static load (pressure or suction) calculated in accordance with Annex A.

Load factors shall be applied as follows:

S_G = 1,35 for the weight, and

S_W = 1,5 for the wind and static loads.

NOTE The load is assumed to be applied when both ends of the element are simply supported.

B.3.4 Fixing devices

All fixing devices, including welds and adhesives shall not fail under the factored wet weight of the elements which they support. In this case the load factor S_G shall be 1,85.

B.4 Calculation and test reports

B.4.1 Assessment of performance by calculation

The calculation report shall include full details of assumptions and parameters used, including:

a) the number and year of this European Standard, i.e. EN 1794-1:2011;

b) the dimensions, including thickness of any reinforcement;

c) the materials used, together with their elastic moduli, elastic limits and other relevant data;

d) the theoretical basis of calculations;

e) the name of the product and the name and address of the manufacturer;

f) the name and address of the certifier of the calculation, with date and signature;

g) a cross sectional drawing with dimensions;

h) the results of calculations and assessment as to whether these indicate satisfactory performance.

B.4.2 Assessment of performance by testing

The test report shall include a full description of the test arrangements, including details of supports, procedures and loading of elements.

It shall also include:

a) number and year of this European Standard, i.e. EN 1794-1:2011;

b) name and address of the testing institute with a dated signature of the person responsible;

c) exact identification of the tested element, the name and address of the manufacturer;

d) full description of the materials and their thicknesses;

e) weight of the element both wet and dry;

f) drawing showing the cross section of the tested element;

g) results of tests; and assessment as to whether these indicate satisfactory performance;

h) number of samples tested.

Annex C
(normative)

Impact of stones

C.1 General

Noise reducing devices placed alongside roads are exposed to the impacts of stones thrown up from the road surface. It is essential that they are resistant to such impacts, only sustaining superficial damage.

This annex provides a standard laboratory test which simulates minor impacts such as those caused by stones thrown up from the road surface. It does not allow for the impact of heavy objects or acts of vandalism.

C.2 Requirements

When testing in accordance with C.3:

a) a hardened steel striker of the dimensions shown in Figure C.1 shall be used;

b) the impact energy of the hammer shall be 30 Nm ± 1 Nm;

c) damage shall be confined to the outer parts of the construction and internal elements shall not be damaged or displaced by the impacts;

d) the striker shall not penetrate the outer wall of hollow elements, but localised damage in the form of splits less than 50 mm long is acceptable;

e) minor damage to the surface of brittle materials in the form of craters (where fragments are broken out) is acceptable, provided that the depth of any crater is less than the thickness of the outer wall or 20 mm, whichever is smaller.

C.3 Test method

C.3.1 The impact of stones shall be simulated by testing with a mechanical hammer, as described in C.3.2 to C.3.4.

C.3.2 Tests shall be made at the following three points within a test area bounded by a margin of 125 mm around the edge of the test panel, on each exposed face as shown in Figure C.2:

a) near one corner of the test area;

b) near the centre of the test area;

c) at one other point within the test area, chosen at random.

C.3.3 The exact position of the points to be tested shall be chosen to be representative of the panel as a whole, by avoiding ribs, or other obvious places of local strength.

C.3.4 Test panels made from materials which become brittle at low temperatures shall be held at - 20 °C for 2 h prior to testing for impact.

NOTE Precautions should be taken to prevent the hammer passing completely through the device under test should it fail completely. In order to ensure the safety of the operator, a solid abutment should be placed approximately 50 mm behind the device opposite the point of impact.

C.4 Test report

The test report shall include a full description of the test arrangement, including details of supports, procedures and location of points of impact.

It shall also include:

a) number and year of this European Standard, i.e. EN 1794-1:2011;

b) name and address of the testing institute with a dated signature of the person responsible;

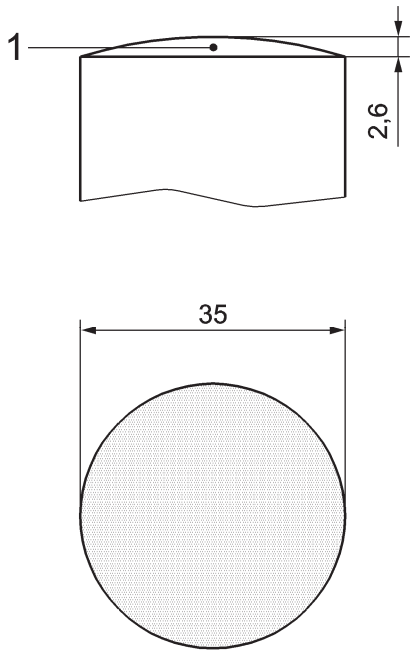
c) exact identification of the tested element, the name and address of the manufacturer;

d) full description of the materials and their thicknesses;

e) drawing showing the cross section of the tested element;

f) results of tests; and assessment as to whether these indicate satisfactory performance.

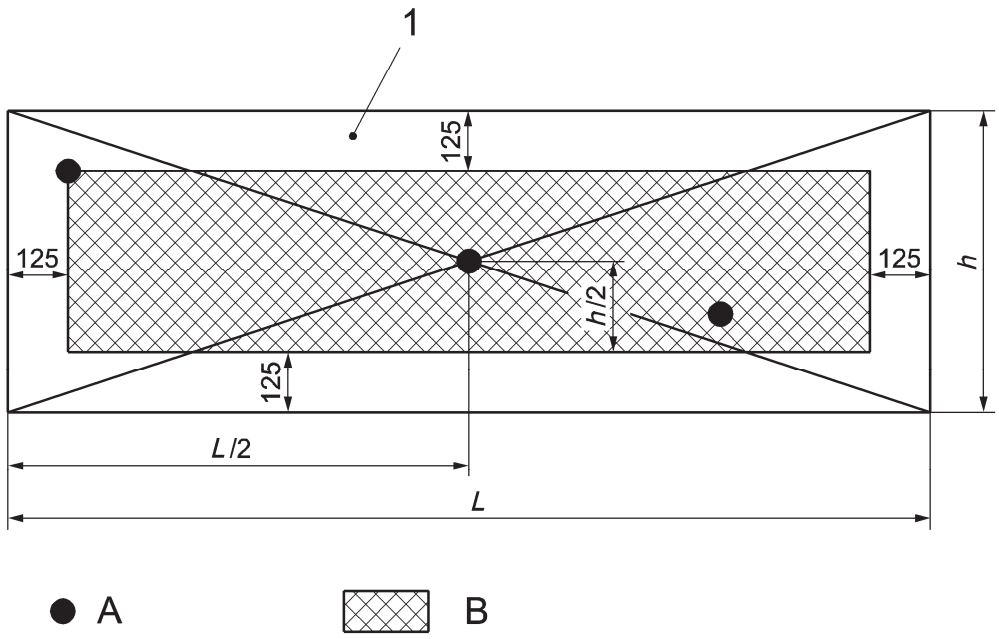
Dimensions in millimetres



Key
1 spherical surface

Figure C.1 — Dimensions of striker point

Dimensions in millimetres



Key
1 element mounted upright as in practice
A impact test points
B impact test area

Figure C.2 — Reference points for impact tests

Annex D
(normative)

Safety in collision

D.1 General

In general, noise reducing devices are not required to withstand vehicle impact. Such impacts may be prevented either by using a road restraint system or by providing adequate distance from the road. Where neither of these options are available, the relevant authorities shall need to consider the consequences of vehicle impact and whether the noise reducing device should itself act as a road restraint system.

This annex applies to noise reducing devices for which the consequences of vehicle impact can be considered to be acceptable from the point of view of the vehicle occupants. The further consequences of the damage caused to a noise reducing device in an impact are considered in EN 1794-2:2011, Annex B.

D.2 Testing and calculations

D.2.1 The safety performance of noise reducing devices in respect of controlling the behaviour of errant vehicles shall be evaluated in accordance with EN 1317-1 and EN 1317-2.

D.2.2 The masses, crash speeds and angles of the test vehicles for which the requirements are fulfilled shall be stated when applied to particular devices.

D.2.3 The acceptance criteria for traffic safe noise reducing devices are as follows.

a) Vehicle occupants safe devices:

   i) elements of the noise device shall not penetrate the passenger compartment of the vehicle. Deformations of, or intrusion into, the passengers compartment that could cause serious injuries are not permitted;

   ii) the vehicle shall remain upright driving after collision, although moderate rolling, pitching and yawing are acceptable;

   iii) the impact severity level shall be A or B, as defined in EN 1317-2;

b) combined safety and noise barriers.

The acceptance criteria are the same as for safety barriers as in EN 1317-2.

Annex E
(normative)

Dynamic load from snow clearance

E.1 General

In areas where snow ploughing is a frequent winter maintenance operation, a noise barrier could be damaged by snow and ice thrown up by the snow plough. The load caused by the thrown snow is here called the dynamic load from snow clearance. The volume and the height of the load depends on the speed and type of the plough, and the distance of the noise barrier from the edge of the road.

If the distance from the ploughed area to the barrier is more than 7 m, wind load is likely to be higher than the dynamic load from snow clearance. The effect of dynamic load from snow clearance on the supports is greatest when a tall noise barrier has its base at lower level than the road surface. Snow ploughing equipment may also throw up pieces of ice, but shocks caused by such means are taken into consideration as impacts caused by stones (see Annex C).

This annex provides a method of calculating the dynamic load from snow clearance, for a range of speeds and distances from the barrier. A method of testing a barrier panel for resistance to the requisite design loading is also provided.

The effect on the dynamic load of absorbing or soft materials on the face of a barrier is not covered in this annex and has to be estimated separately.

Dynamic load from snow clearance is assumed not to act simultaneously with the wind load.

The load due to a plough pressing snow against the noise barrier is not covered in this annex.

E.2 Requirements

E.2.1 Magnitude and height of the load

The dynamic load from snow clearance is a transient horizontal load normal to the barrier. The load shall be assumed to be distributed evenly over an area of 2 m $\times$ 2 m and the resultant force to be located 1,5 m above the level of the road as shown in Figure E.1. The value of the resultant force shall be obtained from Figure E.2.

NOTE It can also be necessary to consider lower positions of the resultant force in the design of acoustic elements.

E.2.2 Mechanical requirements

Under the dynamic load from snow clearance, the structural and acoustical elements shall not show any signs of failure, such as the following: cracks sufficient to cause deterioration in severe corrosive environments; buckling; permanent deformation, or relative movement sufficient to open up joints between panels. Elements shall not become detached from their supports or fixings.

E.3 Methods of assessment

E.3.1 Calculations

In most cases the strength, deflections, relative displacements between the edge of the loaded panel and adjacent unloaded part and other requirements can be calculated. Partial load factor 1,5 shall be used for the characteristic load given in Figure E.2.

Where it is impossible to calculate the strength of the noise reducing device, for example, because of special joints or fastenings, it shall be tested in accordance with E.3.2.

E.3.2 Load test

The element shall be supported on posts or foundations as in normal use, but placed in a horizontal position roadside upwards. Posts may be simply-supported at both ends provided calculation shows that the deflection in the posts caused by the load is less than their length divided by 150. Otherwise the posts shall be clamped at one end.

The dynamic load from snow clearance shall be simulated by laying sand-filled bags onto the element. The weight of the bags per square metre shall be 1,5 times the calculated dynamic load from snow clearance per square metre, minus the weight of the panel per square metre. The load shall be evenly distributed over an area of 2 m $\times$ 2 m so that the resultant force of the load is midway between the posts. The resultant force of the load shall be 1,5 m above the road surface, unless other load positions give a greater deflection or cause more critical loading at the joints; the load position causing the most severe condition shall be used as appropriate.

For some materials, the uniform load distribution can also be simulated using vacuum- or air –pressure test arrangement.

E.4 Test report

The test report shall include:

a) number and year of this European Standard, i.e. EN 1794-1:2011;

b) full description of the test specimen, including manufacturer’s name and product identifier;

c) sectional drawings of panels and mounting conditions, showing all dimensions, including thicknesses of seals;

d) name and address of the organization which performed the measurements or calculation and the name of the person responsible for measurement or calculation;

e) testing conditions, with details of methods used in loading and supporting the posts and panels;

f) amount and the position of the load; the deflection under it; any damage to the panels and posts and the behaviour of the joints and seals during each loading stage;

g) conclusion as to whether the device under test complies with the requirements.

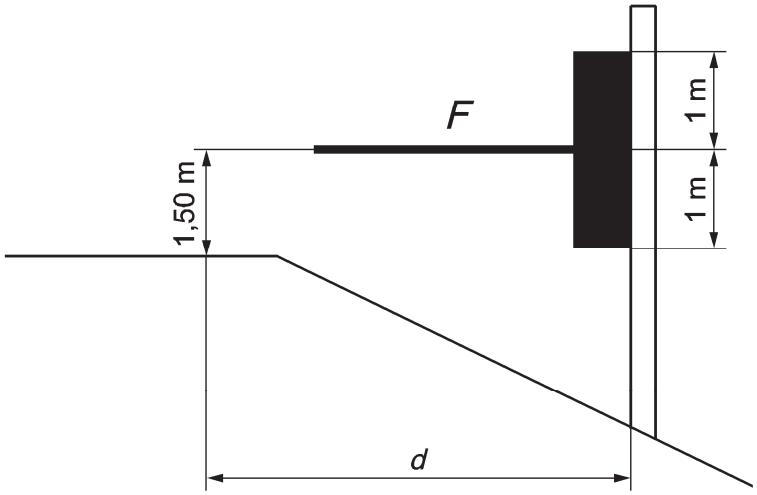
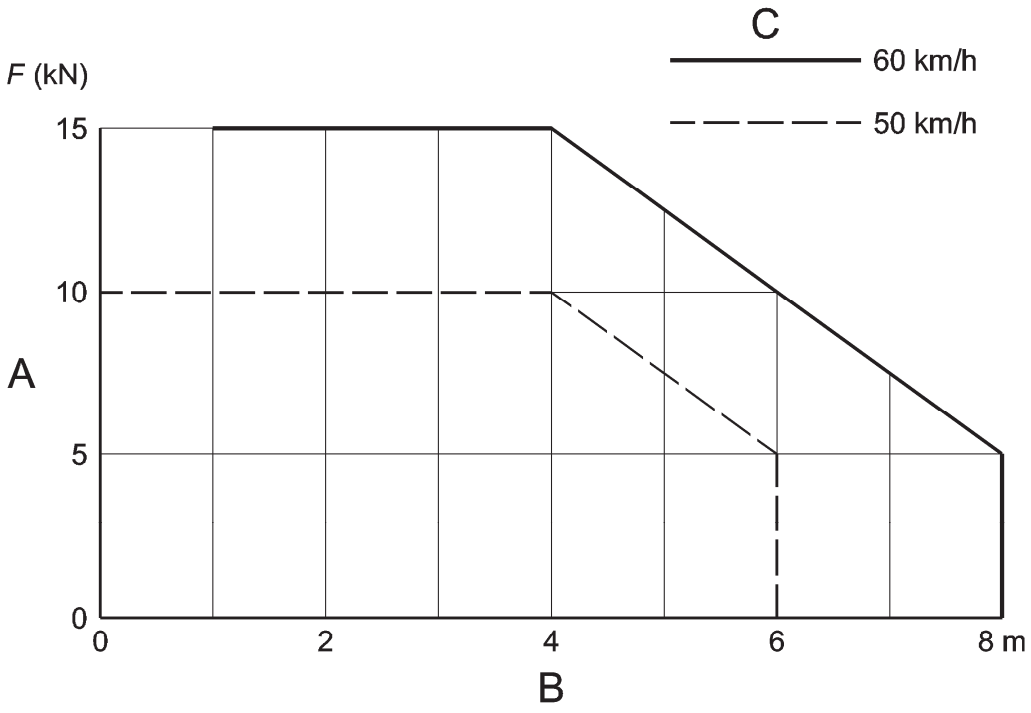


Figure E.1 — The effect of height on the dynamic load from snow clearance



Key
A dynamic load on 2 m × 2 m
B distance *d* from edge of ploughed surface
C ploughing speed

Figure E.2 — The magnitude of dynamic load from snow clearance

Bibliography

[1] EN 1990:2002, *Eurocode — Basis of structural design*

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